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IS 3600-4 (1984): Method of Testing Fusion Welded Joints and Weld Metal in Steel, Part 4: Longitudinal tensile test on cylindrical weld metal test pieces on butt welds [MTD 11: Welding General]

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Welding General Sectional Committee, SMDC 14 [Ref.: Doc : SMDC 14 (2451) F]

Indian Standard

METHOD OF TESTING FUSION WELDED JOINTS AND WELD METAL IN STEEL

PART 4 LONGITUDINAL TENSILE TEST ON CYLINDRICAL ALL WELD METAL TEST PIECES USING BUTT JOINTS

(Second Revision)

1. Scope — Specifies sizes of test pieces and testing procedure for carrying out longitudinal tensile test on cylindrical test pieces in order to determine one or more of the following mechanical properties of weld metal in a fusion welded butt joint :

- a) Tensile strength,
- b) Yield stress and/or stress at proof limit,
- c) Percentage elongation after fracture, and
- d) Percentage reduction of area.

2. Field of Application — This standard applies to ferrous materials, with butt joints made by any fusion welding process having joint sizes sufficient to obtain cylindrical test pieces having the dimensions specified in 5.3.

3. Principle — Application of a tensile load to break a cylindrical test piece taken longitudinally from the weld metal in a welded joint.

3.1 Unless otherwise specified, the test is made at room temperature.

4. Taking of Test Pieces — The test piece shall be taken from a part of a welded fabrication or from a welded test assembly, longitudinally to the welded joint, in such a way that after machining the calibrated part of the test piece consists wholly of weld metal at a suitable distance from the weld boundaries (see Fig. 1).

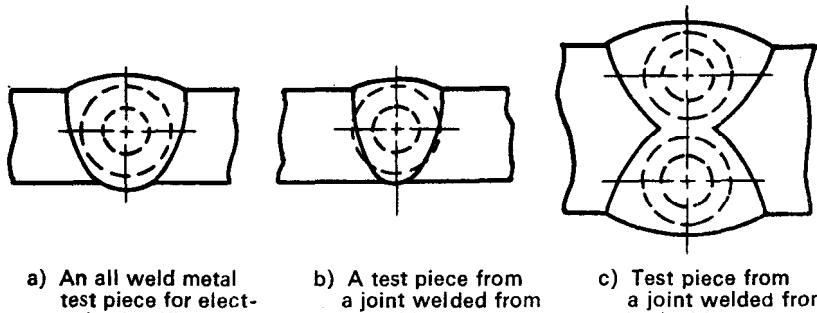


FIG. 1 EXAMPLES OF TAKING TEST PIECES

Note 1 — 'Test assemblies' are welded joints which do not belong to a fabrication, but are made for purpose of approval (for example procedure qualification), control (for example production test coupons) or studies and research.

Note 2 — For the purpose of correctly positioning the test piece in the joint, macro-etching of the joint cross-section at both extremities of the test piece can be made.

4.1 Each test piece shall be marked in such a way that after its removal it is possible to identify its exact position in the part of the fabrication or in the test assembly from which it has been taken. No heat treatment shall be applied to the test assemblies unless it is specified are allowed by the application standard regarding the welded joint or the weld metal to be tested. Heat treatment should be done before machining the calibrated part of the test pieces. Details of any heat treatment shall be recorded in the test report.

4.2 The test piece shall be taken by appropriate means (shearing excluded), if thermal cutting or other methods which could affect the cut surface are used, the cuts shall be made at a distance from the calibrated part of the test piece greater than or equal to 8 mm.

5. Machining of the Test Piece — The test piece shall be machined on a lathe, suitable precautions being taken to avoid superficial strain-hardening or excessive heating of the material.

5.1 Unless stated otherwise in the particular application standard concerning the welded joint under examination, the test piece shall be taken as close as possible to the weld face. In the case of very thick or double sided welded joint, more than one test piece may be taken at different locations through the thickness (see Fig. 1 c), in which case the position of each test piece in the joint cross-section shall be identified.

5.2 The round proportional test specimen shall be used. The form and dimensions of the test specimen shall be in accordance with Fig. 2 and Table 1. The tolerances on the dimensions of the specimen shall be as specified in IS : 1608 - 1972*. The gauge length L_0 corresponds to $5.65\sqrt{S_0}$, where S_0 is the original cross-sectional area of the test specimen.

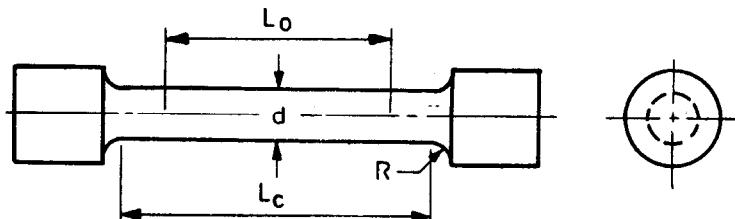


FIG. 2 DIMENSIONS OF TEST PIECE

TABLE 1 DIMENSIONS OF ALL-WELD METAL TEST SPECIMEN
(All dimensions in millimetres)

Cross- Sectional Area S_0 mm ²	Diameter d	Gauge Length L_0	Minimum Parallel Length $L_0 = 5.5 d$ (4)	Minimum Transition Radius (5)
(1) 400	22.56	113	124	23.5
200	15.96	80	88	15
150	13.82	69	76	13
100	11.28	56	62	10
50	7.98	40	44	8
25	5.64	28	31	5
12.5	3.99	20	32	4

Note 1 — The gauge length is given to the nearest 1 mm and the minimum parallel length is adjusted accordingly.

Note 2 — Test pieces other than those given in this table may be used provided that the gauge length $L_0 = 5.65\sqrt{S_0}$.

5.3 The gripped ends of the test piece shall be whatever shape and size are appropriate to the tensile testing machine used.

6. Method of Testing — The specimen shall be tested in tension in accordance with IS : 1608-1972*. The test piece shall be gradually and continuously loaded along its axis until rupture. Unless otherwise stated in the application standard, the speed of loading shall conform to IS : 1608-1972* and be as uniform as possible; in any case possible variations of loading during testing shall be progressive and without abrupt changes.

7. Results

7.1 Tensile Strength — The tensile strength shall be calculated as the ratio between the maximum load carried by the test piece during testing and the initial cross-sectional area of the test piece in the calibrated length, expressed in mega pascals (MPa).

*Methods for tensile testing of steel products (first revision).

7.2 Yield Strees and/or Stress of Proof Limit — According to the requirements of the application standard concerning the welded joint under examination, the values of the upper or lower yield point, or the strees at proof limit or other conventional parameters shall be determined during the tset in accordance with IS : 1608-1972*. The results shall be expressed in MPa.

7.3 Percentage Elongation After Fracture — The percentage elongation shall be determined in accordance with IS : 1608-1972*.

7.4 Percentage Reduction in Area — The percentage reduction of area shall be determined in accordance with IS : 1608-1972*.

7.5 Fracture Examination — After breaking the test piece, the fracture surfaces and gauge length shall be examined and the existence of any defects shall be recorded, including their nature and extent.

7.6 Interpretation of Results — Interpretation of the results shall be made in accordance with the appropriate application standard for the welded joint under examination.

EXPLANATORY NOTE

This standard was first published in 1966 and was revised in 1973 covering various tests on fusion welded joints and weld metal in steel. In view of the experience gained and in order to bring the test and test requirements in line with other international standards published so far, it has been decided to revise this standard in the following parts :

Part 1	Cruciform fillet weld tensile test†
Part 2	Beam impact (Charpy V-notch) test†
Part 3	Transverse tensile test on butt welds
Part 4	Longitudinal tensile test on cylindrical weld metal test pieces on butt welds
Part 5 (ISO 5173-1981)	Transverse root and face bend test on butt welds
Part 6 (ISO 5177-1981)	Transverse side bend test on butt welds
Part 7	Longitudinal root and face bend test on butt welds†
Part 8	Nick break test and fillet weld fracture test†
Part 9	Macro and micro examination†

In this revision free-bend test has been deleted as the ductility of the weld zone is being assessed more and more by other bend tests. Special tests such as tests for the susceptibility to lamellar tearing, reheat cracking, brittle fracture and creep fatigue will be covered in separate standards.

The main purpose of this standard is to recommend test procedures and test specimens that should be quoted or incorporated in engineering application standards that deal with welded constructions primarily for the qualification of welding procedures and operators. Where differences still exist between application standards, the methods of test given in this standard should be preferred.

A general indication is given of the purpose served by the tests specified in this standard but this standard does not indicate the choice of test methods for a particular application nor the number of specimens to be tested or the repeat tests to be allowed in the event of failure. Such requirements are matters to be dealt with in the particular application standards where they exist or to be agreed between the manufacturer and the purchaser.

It should be realized that variations in welding procedure and the preparation of test specimens can give rise to variations in the test results.

In preparing this part of the standard assistance has been derived from ISO/DIS 5178 'Fusion welded butt joints in steel-longitudinal tensile test on cylindrical weld in metal test pieces of the International Organisation for Standardization.

*Methods for tensile testing of steel products (*first revision*).

†Under preparation.